Assessment of the biodiversity of macroinvertebrates populating the Ghara source (plains of sais, Morocco)

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Abstract

Macroinvertebrates of the source Ghara were studied using samples taken seasonally between October 2015 and August 2016. The fauna listed in this work is made up of 4005 individuals corresponding to 35 species belonging to 7 classes. The taxon of insects is the front while the other classes have low percentages not exceeding 8%. These classes are divided into 12 orders. The size of the benthic population has shown that mayflies are the the most representative. In terms of abundance, it is the species Baetis pavidus which holds the front followed respectively by the crustaceans Gammarus gauthieri and Gammarus marocanus. The remaining species are in the minority. The values of the specific diversity index H and the specific fairness index revealed that the specific diversity of macroinvertebrates populating this source is relatively low. The results obtained in this study highlight an alarming state of the ecological state of the source Ghara.

Keywords : Source, Ghara, ecological stat, the specific diversity, macroinvertebrates, species, baetis pavidus, benthic, Gammarus gauthieri.

1. Introduction

It is recognized worldwide that macroinvertebrates are the most frequently used to assess the ecological health of an ecosystem [**1,2**]. This is mainly due to the fact that these organisms are sedentary, have a large number of species and relatively long life cycles which give them the best quality of continuous integrators of the environmental conditions in which they live [**3,4**].Their study makes it possible to assess the real repercussions of pollution and alteration of aquatic and riparian habitats [**3**]. A lack of information on the variability of this fauna constitutes a handicap in the development and implementation of

sustainable development policies and the protection of the quality of aquatic ecosystems [**3,5**].

In Morocco, despite the work already carried out **[6,7, 8]** the importance of the benthos remains little known. The present work reveals the spatial and seasonal variations of settlement by benthic organisms, the parameters that explain this distribution and the ecological state of the Ghara source.

2. Materials and methods
2.1 study area

The Ghara source is located 22km southwest of the city of Fez. It is part of the Fez-Meknes hydrogeological unit. The average flow of this station is 278 l / s. The waters of this emergence are used for the supply of drinking water to neighboring agglomerations and for irrigation (**Figure 1**).
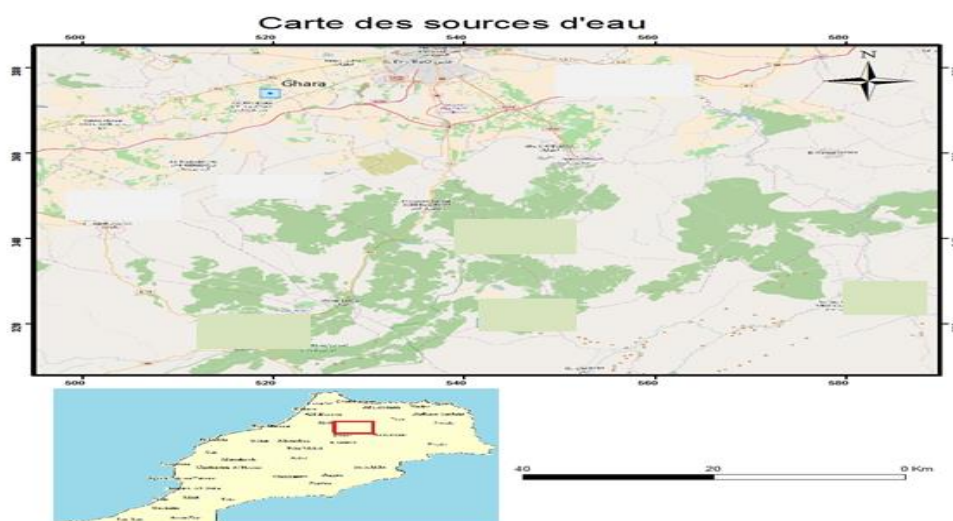

Figure 1 : Location of Ghara station

2.2 Sampling of the macro-invertebrate benthic

For a general sampling, we opted for a surber NET to a width of mesh 400μm. This technique can be used on rocky, Sandy, gravelly and muddy, good that it is difficult on the very organic substrates. In order to collect the maximum of Macroinvertebrates colonizing the site, we should spend 30-45 minutes on the rocky beaches to return stones and search for invertebrates. On detached bodies of stones with pliers and keep them in a jar. The collected samples are fixed at 40% formalin, then stored in water from source to 10%. The sorting of samples is done using the loupe. Zoological groups are separated in vials

containing 70% alcohol [9]. Species in each group are sorted, identified, counted, and classified among functional feeding groups according to [10].

2.3 Calculation of statistical descriptors of data

2.3.1 Specific diversity index

The most used index and the Shannon-Weaver, it reflects the diversity of species that make up the stands in a medium and establishes the link between the number of species and the number of individuals of a same ecosystem or a community. Is calculated using the formula: $H' = -\sum (n_i/N) . Log_2 (n_i/N)$ H': diversity specific N: total number of individuals n_i: number of species i.

Index of species diversity is high, when the taxon richness is important and the distribution of individuals among the taxa is balanced.

2.3.2 Fairness Index

Knowledge of species diversity index is used to determine the fairness; equity is a second fundamental dimension of diversity. It is the ratio between the maximum diversity (Hmax). It varies between 0 and 1, tends towards 0 when almost all of the staff is focused on a species; It is 1 when all species have same abundance. Index of fairness determines, either reconciliation or even the remoteness between H' and Hmax. It is expressed by the formula: $E = H' / Hmax$ $Hmax = Log_2 (S)$ $E = H' / Hmax$ $Hmax = Log_2 (S)$ S: Total number of species.

2.3.3 Relative abundance

Relative abundance of a species is the percentage of the number of it compared to the total number of individuals collected from a station. It is expressed by the formula $Pi = Ab(a)*100/ Ab(t)$ Where, Ab (a): total number of individuals of a species. Ab (t): total number of individuals.

2.3.4 The frequency

The frequency of a species is the ratio, expressed as a percentage, between the total number of samples where this species is noted and the total number of all samples taken. $Fi = Pa * 100 /Pt$ PA: number of samples where the species was collected, Pt: total number of samples.

A species is ubiquitous if its F is 100%, constant if the F is strictly between 75% and 100%, regular if the F is between 50 and 75%, accessory if the F is between 25 and 50% Finally, a species is accidental if F is less than 25% .

3. Results and discussion

3.1 Study of benthic macrofauna

3.3.1. Inventory of the benthic community

4005 individuals were collected during this study. These specimens belong to 7 classes. the taxon of insects is the front (66%) while the other classes have low percentages not exceeding 8% (**Figure2**).
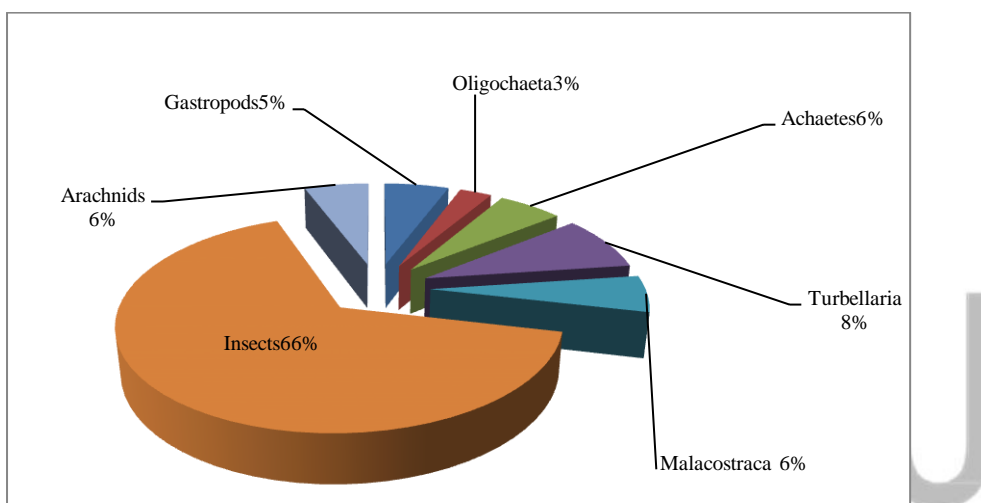

Figure 1 : Percentage of species not taxonomic class in the station of Ghara during the year 2015-2016

Table 1: Seasonal evolution of the abundance of benthic macrofauna in the station of Ghara during the year 2015-2016

Species	Oct	Nov	Janv	Mars	Avr	Mai	Juil	Aout
Melanopsis praemorsa	5	7	4	8	11	9	15	17
Thiodoxus numidicus	1	2	0	4	6	7	9	11
Haplotaxis sp.	3	5	2	6	7	8	10	6
Glossiphonia sp.	4	6	2	3	7	9	8	6
Helobdella sp.	3	5	2	4	6	7	11	7
Polycelis nigra	11	9	4	7	11	9	8	10
Phagocata sp.	6	5	2	4	8	11	5	7
Dugesia sp.	2	1	0	2	5	6	2	5
Gammarus gauthieri	90	94	97	100	107	119	115	98
Gammarus marocanus	89	92	95	97	100	102	133	95

Simulium wilhemia	6	5	3	5	7	8	7	6
Simulium mellah	1	0	0	1	1	3	1	3
Simulium pseudoquinum	13	11	6	4	8	9	10	11
Simulium velutinum	2	1	0	1	3	1	4	0
Gerris sp.	2	1	0	3	4	6	0	0
Mesovelia sp.	2	1	0	2	1	1	4	2
Microveila sp.	0	1	0	2	1	3	1	0
Naucoris sp.	2	1	0	1	3	4	5	3
Baetis rhodani	20	17	10	8	13	6	15	10
Baetis pavidus	137	134	129	131	139	130	136	134
Baetis alpinus	20	22	15	16	18	20	22	21
Centroptilum sp.	59	56	30	34	36	40	44	52
Traulus sp.	1	0	0	0	1	2	0	0
Procleon sp.	5	0	0	3	4	2	5	4
Caenis luctuosa	2	1	0	3	4	3	6	11
Caenis pusilla	0	0	0	2	4	1	2	3
Elmis sp.	0	0	0	0	1	0	0	0
Riolus sp.	0	0	0	1	0	0	0	0
Hydranea sp.	0	0	1	0	0	3	0	3
Rhartus sp.	1	0	0	1	0	1	1	1
Rhyacophila sp.	0	0	1	3	4	2	0	0
Diplectrona sp.	0	0	0	1	2	1	0	0
Cheumatopsyche lepida	0	0	0	3	1	2	1	0
Hydrachnidia sp.	0	1	0	2	3	1	0	0
Arrenurus sp.	0	1	2	3	1	0	0	0

3.3.2 Total abundance

In terms of abundance, among the 7 classes identified, 43.52% represent ephemeroptera. These are the Amphipods which come second (40.52%). The remaining groups are very weakly represented (**figure3**).
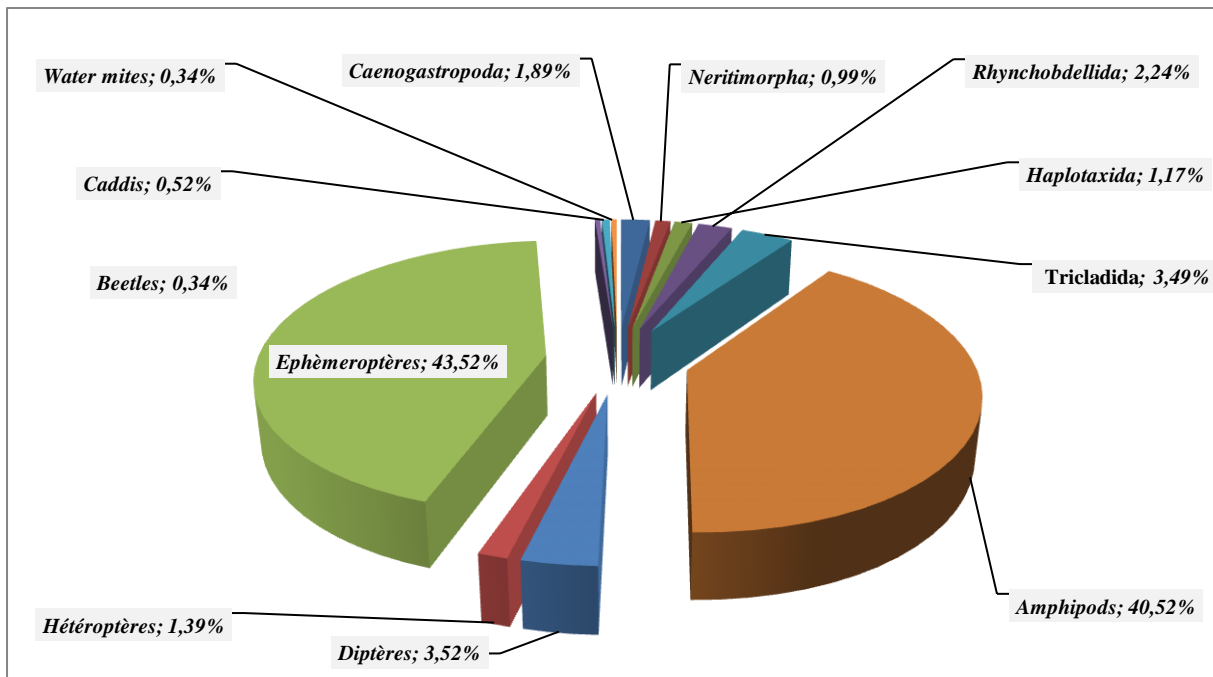
Figure3 : Abundance of different orders in Ain Ghara

3.3.3 Relative abundance

At this source, the results reveal that it is the species Baetis pavidus which holds the front in terms of abundance with a value (in percentage) equal to 26.7% followed respectively by the crustaceans Gammarus gauthieri (20.4 %) and Gammarus marocanus (20%). The remaining species are in the minority (**Figure4**).

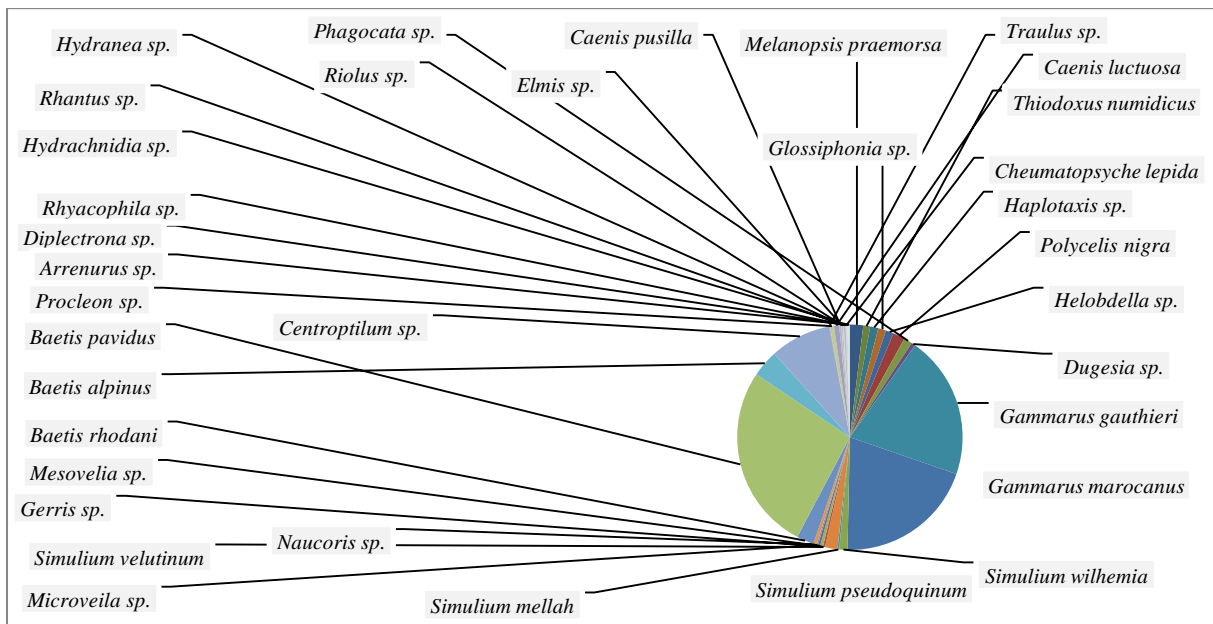**Figure4** : Relative abundance of different taxa in the source of Ghara

3.3.4 Specific diversity index

Analysis of the stands of macroinvertebrates collected during the study period revealed that the Ghara station has a relatively low specific diversity index. It is equal to 0.1. This is the result of a correlation of different biotic and abiotic parameters which have affected the existence of different species in this station such as the homogeneity of substrate, the overexploitation of water resources intended for drinking water and l irrigation of neighboring agricultural land. Without forgetting the effects caused by ecotourists who frequent this aquatic ecosystem at all times of the year.

3.3.5 Specific fairness index

The fairness index found in this source is 0.02. This reflects that the species confined to this station do not have the same abundances. This alarming situation must prompt the authorities to formulate a legal arsenal within the framework of safeguarding this aquatic ecosystem.

3.3.6 Frequency

The constant species which permanently confine the Gh source represent more than three quarters of the total benthic fauna, the accessory species are 3 in number while the accidental species are 2 (**Tab.2**).

Tab.2 : Frequency of occurrence of species colonizing the Ain Ghara source

Species	Frequency(%)	Presence
Melanopsis praemorsa	100	
Thiodoxus numidicus	87,5	
Haplotaxis sp.	100	
Glossiphonia sp.	100	
Helobdella sp.	100	
Polycelis nigra	100	
Phagocata sp.	100	
Dugesia sp.	87,5	
Gammarus gauthieri	100	
Gammarus marocanus	100	
Simulium wilhemia	100	
Simulium mellah	75	
Simulium pseudoquinum	100	
Simulium velutinum	75	
Gerris sp.	62,5	constants (≥50%)
Mesovelia sp.	87,5	

Microveila sp.	62,5	
Naucoris sp.	87,5	
Baetis rhodani	100	
Baetis pavidus	100	
Baetis alpinus	100	
Centroptilum sp.	100	
Procleon sp.	75	
Caenis luctuosa	87,5	
Caenis pusilla	62,5	
Rhartus sp.	62,5	
Rhyacophila sp.	50	
Cheumatopsyche lepida	50	
Hydrachnidia sp.	50	
Arrenurus sp.	50	
Diplectrona sp.	37,5	25< accessory <50
Hydranea sp.	37,5	
Traulus sp.	37,5	
Elmis sp.	12,5	accidental ≤25
Riolus sp.	12,5	

4. Conclusion

The study carried out on the aquatic Macroinvertebrates of the Ghara source highlighted a qualitative and quantitative taxonomic richness not very important. Seasonal sampling at the water level of this aquatic ecosystem gave a total of 4005 individuals belonging to 35 species distributed between 12 orders and 7 classes. All these biological, ecological and landscape characteristics make this site of great interest, hence the need to safeguard it by classifying it, within the framework of the National Study on Protected Areas as SIBE (Site of Biological and Ecological Interest).

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